

CLAIMS

1. An image processing system having image data processing means of segmentation of an object of interest using an unstructured deformable mesh model composed of surface discrete elements and internal discrete elements, and further comprising means of refining the unstructured deformable mesh model by automatically dynamically adapting the size of the internal discrete elements according to the local variation of size of the surface discrete elements.
2. The image processing system of Claim 1, further comprising image data processing means for acquiring size information related to the surface discrete elements in order to evaluate the optimal size to be assigned to the internal discrete elements, and for propagating this size information from the surface discrete elements to the internal discrete elements while new internal discrete elements are created during the refinement process.
3. The image processing system of Claim 2, wherein new internal discrete elements are created during the refinement process by insertion of new vertices inside said internal discrete elements.
4. The image processing system of Claim 3, comprising image data processing means to estimate mesh quality of the internal discrete elements and to refine the unstructured mesh model based on said estimated mesh quality.
5. The image processing system of Claim 4, wherein the unstructured mesh model is a 3D mesh model with surface discrete elements composed of triangles (T_j), and internal discrete elements composed of tetrahedrons (TH_j); or the unstructured mesh model is a 2D mesh model with surface discrete elements composed of contour segments, and internal discrete elements composed of triangles (IT_j).
6. The image processing system of Claim 5, wherein, in 3D, the internal tetrahedrons (TH_j) are initially constructed based on the vertices of the surface triangles and then refined by inserting vertices either at the middle of a tetrahedron edge; at the middle of a tetrahedron face; at the center of a tetrahedron; or at the center of the circum-sphere of a tetrahedron;
or wherein, in 2D, the internal triangles (IT_j) are initially constructed based on the vertices of the contour segments and then refined by inserting vertices either at the middle of a triangle edge; at the middle of a triangle face; or at the center of a triangle.
7. The image processing system of one of Claims 5 or 6, comprising:

image data processing means to estimate a weight parameter (L_j) assigned to each vertex of the discrete elements based on the average of the lengths of the edges joining said vertex to its neighbor vertices; an optimal volume or surface associated to each internal discrete element, the optimal internal discrete element shape being a regular tetrahedron or triangle and the real volume or surface of each initial internal discrete element; and image data processing means for comparing the real volume or surface with respectively the optimal volume or surface and accordingly to initiate a refinement of an internal discrete element under study if the real volume or surface of the internal discrete element is bigger than its optimal volume or surface.

8. The image processing system of Claim 7, comprising image data processing means to estimate a validity criterion according to which a new internal element is valid if and only if its circum-sphere or circum-circle encloses no other vertex of the mesh.
9. The image processing system of Claim 7, wherein the image data processing means to estimate mesh quality of the internal discrete elements comprises a criterion based on the length of edges of the internal discrete elements and the diameter of its circum-sphere or circum-circle, and a criterion based on the volume or surface of the internal discrete elements.
10. The image processing system of one of Claims 1 to 9, further comprising visualizing means (60) for displaying processed images.
11. The image processing system of one of Claims 1 to 10, further comprising means for stopping the refinement of internal discrete elements when a predetermined threshold of mesh quality is met.
12. A medical imaging system comprising a suitably programmed computer or a special purpose processor having circuit means, which are arranged to form an image processing system as claimed in one of Claims 1 to 11 to process medical image data;
13. A medical examination imaging apparatus having:
 - Means to acquire a three-dimensional image of an organ of a body; and
 - a system according to one of Claims 1 to 12.
15. A computer program product comprising a set of instructions to be used in a system as claimed in one of Claims 1 to 12.